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Annual Fluctuations (~10^{-12} W·m^{-2}) in Ground Level Photon Power Densities: Quantitative Evidence for Possible Modulation From the Galactic Center

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Abstract: The numbers of photons per second for more than a year (2013-2014) recorded every ~2.5 s by a digital photomultiplier unit was maximum during August to October and minimum during February through April. The peak-to-peak difference in quantity for the classical, smooth variation was 2.4 x 10^{-12} W m^{-2}. This value is within the order of magnitude for a photon source from the galactic center with a power of 10^{59} J from a spherical surface with a radius defined for a singularity that could be equivalent to the galactic mass. The calculated change in photon flux density from such a source for the annual change in the earth's distance around the sun relative to the distance to galactic center was ~10^{-21} W m^{-2} or equivalent to 10 Solar Flux Units (SFU). Data obtained for daily SFU for the years 2009 through 2013 indicated that an average difference was 8 to 10 SFU higher for September-October when the earth would be closer to the galactic center than March-April. The most likely source of the amplitude of the annual variation is consistent with modification by the earth's position in the solar mass field with respect to the galactic center. These data suggest that at least a subset set of background photon emissions on the earth's surface display a clear annual variation whose source could originate from a singularity at the distance of the center of the Milky Way.

Keywords: Photon Flux Density, Annual Variation, Galactic Center, Singularity

1. Introduction

Fluctuations in the measurements of photon density on the earth's surface have constituted one of our primary methods by which we have inferred the structure and function of the galaxy and its constituents. Contemporary interpretations suggest the center of the galaxy is a singularity. Considering the pervasiveness of the gravitational attraction and the potential intrinsic relationship between gravitational energies and photons [1-3] one would predict that annual variations in threshold values of photon flux density could occur on the Earth's surface. In our laboratories the intrinsic values are in the order of 10^{-12} W m^{-2} based upon measurements by photomultiplier units [4-5].

Although the orbital diameter of ~10^{11} m around the sun is small compared to the approximately 2.6 x 10^{20} m distance to the center of the Galaxy, the consequences of an inverse-square relationship should still be evident. Because of the oblique angle of the ecliptic of the solar system compared to the sun's orbital vector around the galaxy one would predict that the strongest measurements would occur during months around the Autumnal Equinox when the earth is closest to the galactic center and least around the Vernal Equinox. Any integrated measurement over a year interval should demonstrate a smooth alteration as a function of time.

Sensitive photometric discernment by active focusing through telescopic equipment has revealed dynamics of stellar objects. For example double stars have traditionally been inferred when periodic fluctuations in flux density suggest periodic eclipses. The utilization of photomultiplier units to constantly monitor ground level photon counts has not been systematic. The ease of access to modern digital photomultiplier units for constant measurement has opened new possibilities for inferring longer duration background fluctuations for terrestrial and galactic sources. Here I present evidence that annual changes in the power density of

background photon levels may reflect a source from the central region of the galaxy.

2. Materials and Methods

Between July 2013 and the end of October 2014 the numbers of photons per second were collected by a photomultiplier device. It was a Model DM0090C digital multiplier unit from SENS-TECH, LTD. The aperture was placed facing upwards and was flush with the floor at 46.29 latitude and 81.0 W longitude. According to manufacture's specifications the sensitivity for photons included the range of 280 to 850 nm. The numbers of photon impacts were recorded by a laptop computer once every 2.5 s (32,000 counts) for 22.5 hrs per day (the limit of the computer software) every day during the year period. The unit was housed in a blackened box in the dark on the basement floor in a one-story wooden structure and was covered with several layers of black terry cloth. Operating monitoring lights or complete darkness with this arrangement did not alter the photon counts. The temperature was controlled within 1° of 22° C; relative humidity ranged between 38 and 48%. Intermittent ambient light did not affect the readings. The data from every Tuesday, for convenience, for the weeks that elapsed during this period were obtained and averaged. All subsequent analyses employed PC SPSS 16 software.

3. Results

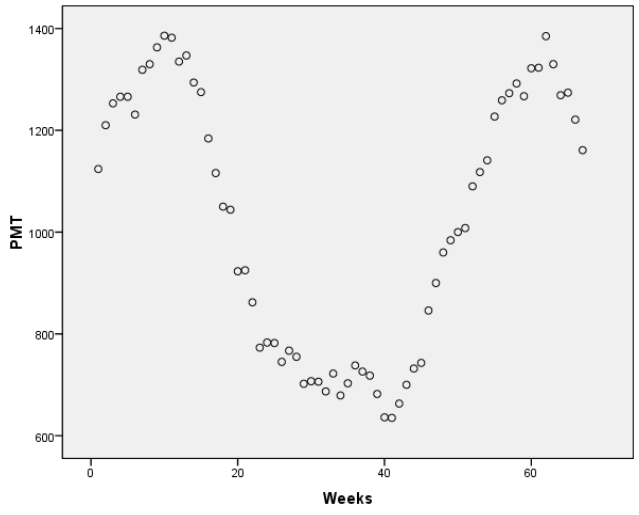

Figure 1. *Average photons counts per second per day (PMT) over one earth's orbit. The measurements were collected from July 2013 through October 2014.*

The results are shown in Figure 1. The annual variation profile associated with one earth orbit was conspicuous. The mean numbers of photons per second displayed a maximum during August to October and a minimum during February through April. The difference between the maximum and minimum was ~700 photons per s. Assuming the mid-range of 550 nm which is 3.6 x 10^{-19} J per photon, the value would be equivalent to ~2.4 x 10^{-12} W m^{-2}. The continuity of this variation was suggested by the very similar values for 16 July 2013 (the first week of the measurement) and 16 July 2014. The means and standard deviations for the numbers of photons per sec were 1124 (29) and 1119 (25), respectively, which is less than one-quarter of a standard deviation. Concurrent overlaps between years were consistent. For example the mean and standard deviation for photon counts on 17 September 2013 were 1386.0 and 26.2, respectively. The values for 16 September, 2014 were 1385.3 and 24.9, respectively.

4. Calculations and Estimates

Assuming ~2.5 x 10^{-12} Wm^{-2} for the net difference in flux density between the largest (during September) and smallest (April) values and an approximate distance of 27 kLY or 2.6 x 10^{20} m from the center of the galaxy, the reversed inversed square of 6.8 x 10^{40} m^2 for 2.5 x 10^{-12} W m^{-2} would predict a power density of 1.7 x 10^{29} W for a square meter at the source.

The Schwartzchild radius (R) for the galaxy according to:

$$R=2MGc^{-2} \quad (1)$$

where M is the mass, G is the Newtonian Gravitational Constant and c is the velocity of light in a vacuum would be 3.0 x 10^{14} m. This assumes there are 10^{11} stars in the galaxy and the average mass of the stars is similar to the Sun, ~2 x 10^{30} kg.

If a spherical shape for the singularity is assumed, then the surface area of an object with that radius would be 1.1 x 10^{30} m^2. Hence the total power from that source would be the product of this surface area and the predicted power density or 1.4 x 10^{59} J. The mass equivalent, by dividing by c^2 would be around 10^{42} kg. Assuming the average mass of the Sun, this would be equivalent to 10^{11} stars which is within the range of the 2 to 6 x 10^{11} stars estimated by more direct measurements.

Current perspectives suggest that the center of the galaxy would be closer to the earth during the Autumnal Equinox, when the photon counts were highest, compared to the Vernal Equinox. However the distance of $3 \cdot 10^{11}$ m for the earth's orbital diameter is extremely small compared to the distance to the center of the galaxy. Assuming the same inverse-square relation the change in flux power density in proportion to the 2.6 x 10^{20} m from the galactic center would be about 10^{-21} W m^{-2}. This value when accommodating the frequency unit is within an order of magnitude of a Solar Flux Unit (SFU) which is 10^{-22} Wm^{-2} Hz, or about 10 SFUs.

To discern if there is a change of 10 SFUs between the closest (September-October) and further (March-April) distance from the galactic center monthly means for five years of daily SFU data were obtained from NOAA Penticton F10.7cm index which is measured at local noon (2000 UTC). The measure has a bandwidth of 100 MHz centered at 2.8 GHz. For all 5 years the numbers of SFU units, regardless of background (range 69 to 125 SFU), were higher for September and October compared to March and April. The mean difference was between 8 and 10 SFU.

To produce the change of flux densities between the

equinoxes the distance to the center of the galaxy would be required to change about 0.8 x 10^{20} m every earth year. This seems unlikely given the estimated diameter of the singularity would be 3 x 10^{14} m. On the other hand if the effective energy of the singularity with that diameter was rotating such that there were perigee and apogee equivalents, the required change would be ~1.2 x 10^{-6} of the total energy of 1.4 x 10^{59} J, or, 1.7 x 10^{53} J. This is the energy equivalent of 1.9 x 10^{36} kg or ~10^{6} solar masses for every earth orbit. The two limiting features of this interpretation is the extremely low likelihood of the coincidence that the earth's rotation would be coupled so strongly to the rotation of the singularity and the required velocity 0f 0.2 c (velocity of light in a vacuum) that results from movement around the singularity's circumference (1.9 x 10^{15} m) to complete one orbit in ~3.15 x 10^{7} s (one earth year).

The other potential interpretation would be a mass effect from the sun upon the photon field from the direction of the galactic center. The proportion of duration of the three lowest photon density months and three highest density photon months involves a subtended angle of about 90° on the side closest to the center (the sun behind the earth) and further from the center (the sun in front of the earth) of the Galaxy. Assuming the deflection of the intergalactic field by the sun to be about 5 to 10 x 10^{-12} T (kg A^{-1} s^{-2}), which is well within the range of measurement interstellar magnetic fields [6] and amplified weak "seed fields" [7], the influence upon a unit charge (1.6 x 10^{-19} As) multiplied by the square (2.0 x 10^{18} Hz) of the frequency of neutral hydrogen (1.4 GHz) results in between 1.6 and 3.2 x 10^{-12} kg s^{-3} or W m^{-2}. If this were valid then the smooth periodicity of the peak-to-peak variations could reflect the four-dimensional geometry of the effect of the solar mass field upon the photon field in the direction of the galactic center. The contribution of the sun's photons to the variation in radiant flux density measured in this study is not likely because the major distance effects are related to solstices and not equinoxes.

5. Discussion and Conclusions

There is one caveat and a low probability mechanism that should be acknowledged. The photon flux density values for the numbers of photons per second recorded by the digital photomultiplier unit was based upon an average wave length (and implicit energy) of 555 nm. The distributions of the actual photon energies within the detection band were not measured. Secondly, the data do not reflect when the photons would have been emitted from the galactic center. Considering the recent, although limited, experimental evidence [8] that two circular (rotating) magnetic fields with slightly shifting angular velocities set the conditions for excess correlations in photon emissions between two loci separated at non-traditional distances, the possibility that a coupled rotation between the galactic core and the earth around the sun might facilitate analogous excess correlation or "entanglement" might be considered.

The probability is very low that these conspicuous changes in photon flux density were due to artifact. There are several arguments for why these were not dark counts or "measurements" of the intrinsic current within the photomultiplier unit's operation. First, dark counts for a given unit running continually would not be expected to change in such a systematic manner over a year. Second a change by a factor of 2 in photon energies matched that expected for the fluctuations from the predicted energies from a source at a distance estimated to be the center of the galaxy and the likely location of the singularity. Third, the September-October peak vs March-April trough of an average of 8 to 10 solar flux units occurred during the same intervals as the photon flux density measurements reported here.

Although the change in relative distance of the earth in its orbit at the most proximal and most distal positions with respect to the galactic center may appear trivial the calculated difference in photon flux density expanding from that center would still be expected to occur and to have a discrete value. The PMT measurements were consistent with the calculated values. The probability is very low that the quantitative solution for the peak-to-trough changes in photon counts (and hence energy) would converge with the calculated value for the intensity of energy from a singularity derived from Schwartzchild's equation at the earth's distance from the galactic center due to random variation.

Direct measurement with a digital photomultiplier unit for more than one year displayed a clear annual periodicity whose flux density would be consistent with an energetic source from the expected mass equivalent of a singularity in the center of the galaxy. Estimates by calculation indicate that the solar mass may affect this periodicity because the earth is behind or in front of the sun with respect to the galactic center which corresponds to the minimum and maximum photon counts, respectively. This source may contribute quantitatively to solar output as inferred by the average shift in 10 SFU during the autumnal (highest) and vernal (lowest) periods. The coefficients may vary for the final estimates of this effect. In the balance of probabilities there is a photon source from the direction of the center of the galaxy. Near this boundary contemporary measurements have indicated that movements of even large masses (e.g., star S2) could exceed [9,10] the fine structure velocity (2.19 x 10^{6} m s^{-1}).

Dedication

The manuscript is dedicated to the memories of Sir Arthur Eddington and Ernst Mach.

Additional Note

Two years have now elapsed for these daily measurements. The correlation (Pearson r) between the 52 weekly (Tuesdays) values for July 2013-2014 and the 52 weekly (Tuesdays) values for July 2014-2015 was r=0.983. The slope of the regression for the latter values compared to the 2013-2014 values was 0.93 (Standard Error=.025).

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